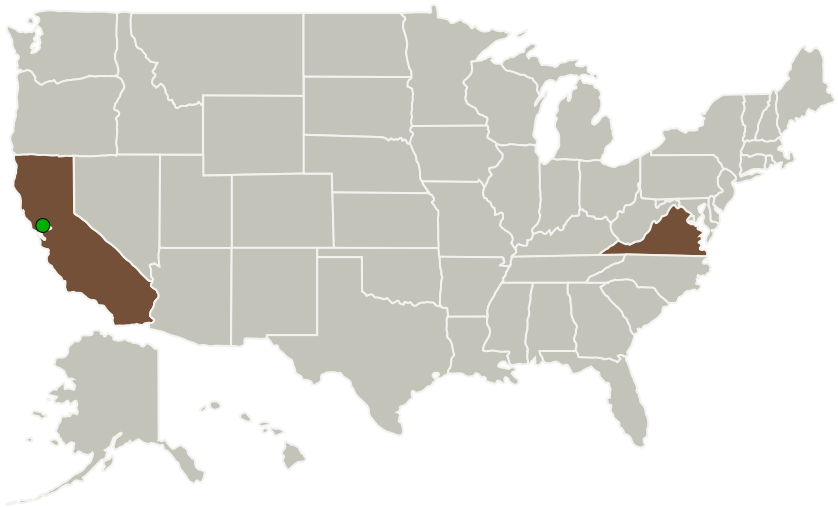
# Advanced Metal Rubber Sensors for Hypersonic Decelerator Entry Systems, Phase I

Completed Technology Project (2012 - 2012)

## Project Introduction

NanoSonic proposes to design and develop light-weight, low-modulus, and durable Metal Rubber™ sensors for aeroelastic analysis of Hypersonic Decelerator Entry Systems (HDES), which would in effect increase the systems aerodynamic stability by contributing to optimize its design. The in-situ Metal Rubber™ (MR™) strain sensors would be utilized to monitor drag at varying Mach flow regimes (subsonic to hypersonic) by analyzing dynamic pressures, and billowing effects (or similar shape-change / inflation effects) of the inflatable system as it goes through simulated re-entry flow regimes in wind tunnel tests and in-flight. The novel MR™ sensors have proven the ability to monitor aerodynamic events, particularly shear and normal forces, based on their response to applied strain. These previous sensor technological advancements will be modified to develop the proposed sensor system for monitoring dynamic loading of HDES. Because commercial strain gauges are not capable of withstanding such high strain levels, and photogrammetric analysis can be cumbersome and is not possible in all wind tunnel tests or in-flight analyses, MR™ sensors are ideal for the proposed application. Lightweight MR™ sensor appliqu¿s can be attached onto HDES materials, integrated in or under the system coating matrix for in-situ non-invasive and even wireless monitoring.

## Primary U.S. Work Locations and Key Partners

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**Small Business Innovation Research/Small Business Tech Transfer**

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| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Nanosonic, Inc. | Lead Organization | Industry | Pembroke, Virginia |
| Ames Research Center(ARC) | Supporting Organization | NASA Center | Moffett Field, California |

| Primary U.S. Work Locations | |
|---|---|
| California | Virginia |

## Project Transitions

**February 2012:** Project Start

**August 2012:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/137963)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Nanosonic, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

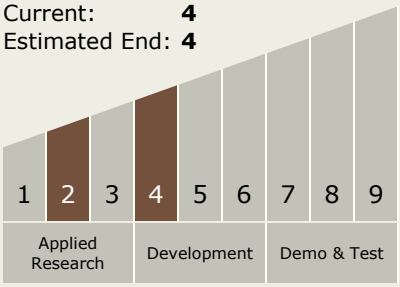
Carlos Torrez

**Principal Investigator:**

Richard O Claus

## Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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## Technology Areas

**Primary:**

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.6 Instrumentation and Health Monitoring for EDL

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System